

#### ABSTRACT OF THE DISCLOSURE

An oxygen-based biomass solid fuel combustion system and method has an air separator for separating oxygen from air providing a supply of oxygen for feeding oxygen to a solid fuel combustion chamber. An airlock feeds a metered amount of solid fuel to the solid fuel combustion chamber. A burner stage having a firetube for collecting fuel gases from the solid fuel combustion chamber combusts the collected fuel gases with further oxygen from the separator and heats a boiler to generate steam. A heat utilization device (e.g. an electrical generator) may be connected to the steam boiler. Nitrogen-free diluent gases (e.g. argon and carbon dioxide) are used to control combustion process temperatures. The usable heat energy and useful byproducts are extracted from the different stages of the process.